



Child injury mortality in Iran: A systematic review and meta-analysis

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ABSTRACT

Background: Reducing child injury mortality is an important factor in directing national and international policy-makers to program appropriate cause-specific interventions. The systematic review and meta-analysis study was performed to provide a clear view of child injury mortality in Iran.

Methods: A systematic electronic search of PubMed, Scopus, Web of Science, SID, and Elmnnet was performed to identify the Persian and English articles published between 2005 and 2018. All studies reporting child injury mortality were gathered according to our inclusion and exclusion criteria. After quality appraisal, data were extracted and analyzed.

Results: Twelve studies with an overall sample size of 22,721 met our inclusion criteria. The prevalence of mortality due to road accident, falling, drowning, poisoning and other causes of death were 56.8%, 11.3%, 8.6%, 5.7% and, 17.6%, respectively. The proportion of injury in all-cause mortality in 0–19 and 0–6 age groups were 11.9% and 16.9%, respectively.

Conclusion: Our findings suggest a relatively high mortality rate for road traffic accidents, which should be taken into account seriously. Developing preventive policies is essential to achieve better standards of road transportation and reduce related mortality in Iran.

1. Introduction

Child mortality is a major indicator of children's health and country's development (EISELE et al., 2005; WorldHealthOrganization, 2000). Millennium development goals (MDGs), developed in 2000 by world leaders, targeted reducing under-five mortality rate (U5MR) – defined as the probability of dying between birth and exactly five years of age, expressed per 1000 live births – by two thirds by 2015 (WorldHealthOrganization, 2000). Since then, several studies have been conducted on child mortality worldwide (R. E. Black et al., 2010a; Hill et al., 2012; Liu et al., 2012a; Murray et al., 2007; Oestergaard et al., 2011; Rajaratnam et al., 2010).

A significant progress was made in reducing child mortality during the past 25 years and the global U5MR declined from 91 deaths per 1000 live births in 1990 to 43 in 2015. However, it was not enough to achieve the MDG 4 target. Therefore, as we are passing

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through post-2015 era, new developmental goals are set as sustainable development goals (SDGs), which states that countries are committed to reduce their U5MR to 25 or fewer deaths per 1000 live births by 2030. These new strategies are focused on the elimination of preventable deaths of newborns and children under five years old (Robert E Black et al., 2010b; You et al., 2015).

Accidents are considered a common and preventable cause of child mortality, accounting for about 324,000 deaths worldwide (Liu et al., 2015a). The growing incidence of road accidents, as well as environmental hazards and less attention of parents can put children, especially those under 5 years old, at the risk of accident-related injury and mortality. In low- and middle-income countries, injury-related child mortality rate is three to four times higher than in high-income countries (Lili et al., 2017). Moreover, access to frequently updated information on the rate and causes of accident-related child mortality is of utmost importance for directing national and global policy-makers to plan for appropriate cause-specific interventions and determine research priorities (Robert E Black et al., 2010b; Du et al., 2007; Liu et al., 2012b; Liu et al. 2015b; Liu et al. 2016; Peden, 2008; You et al., 2015).

Unlike the reports of world health organization (WHO) from eastern Mediterranean region (EMRO), unintentional injuries including accidents have been reported as the most common cause of child mortality in Iran with a prevalence of 20.5% (Liu et al., 2016; Rahbar et al., 2013). Due to these inconsistencies and lack of data regarding the rates and causes of accident-related child mortality in Iran, this study was aimed to perform a systematic review and meta-analysis of all the valid reports to provide a clear view of accident-related child mortality in Iran.

2. Methods

2.1. Literature search

Major databases of Persian literature including Scientific Information Database (SID), Elmnet, and Magiran, as well as selected English electronic databases were including Scopus, PubMed, and Web of Science were searched. All articles published in either

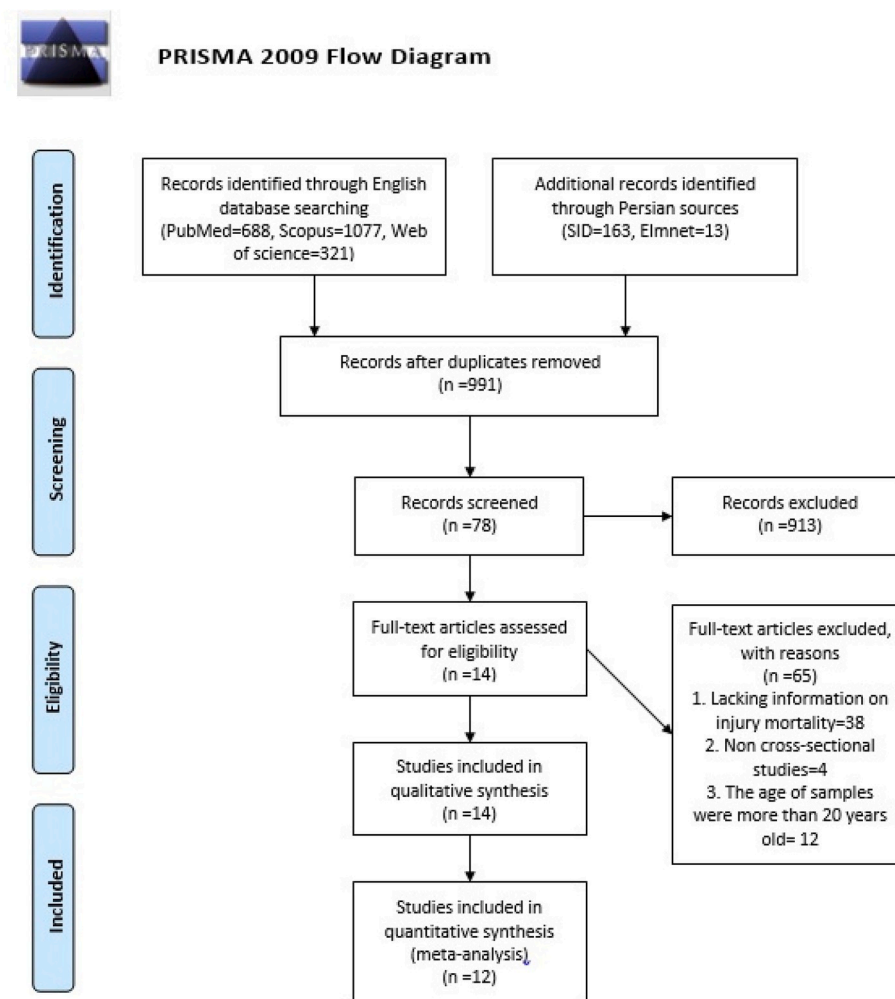


Fig. 1. PRISMA flow diagram of the study.

Table 1
Characteristics of the included studies.

Author, Publication year, City or province	Sample size (n)	Age range (years)	The amount of injury mortality (n)	The proportion of injury mortality to total mortality (%)	The amount of road accident (n)	The proportion of road accident mortality to total injury mortality (%)	The amount of drowning mortality (n)	The proportion of drowning mortality to total injury mortality (%)	The amount of poisoning mortality (n)	The proportion of poisoning mortality to total injury mortality (%)	The amount of falling mortality (n)	The proportion of falling mortality to total injury mortality (%)	Quality Assessment
Memarzade, 2009, Esfahan Izadi et al., 2016,	2300	0-15	94	25%	64	68%	4	4%	1	1%	9	9%	High

[illegible]

^a Villages in 13 provinces of Iran were randomly selected.

^b Newborn deaths recorded in all Iranian hospitals in the year 2012 were entered into the system for the registration of child deaths.

^c Data was obtained from 40 medical universities in order to cover all parts of Iran in 2009.

Data was obtained from Tehran, Karaj, Savojbolagh, Robatkarim, and Shahriar.

English or Persian languages, between 1 January 2005 and 31 October 2018 providing information on frequency, rate, and cause of injury-related mortality in children under 19 years old, especially those under 5 years old were retrieved. We expanded our search manually for non-indexed articles, abstracts from national and international congresses and meetings, and gray literature to identify additional related studies. References of the selected articles were also searched for additional studies.

Our search terms included “injury”, “falling”, “traffic accident”, “poisoning”, “drowning”, “prevalence”, and “mortality”. Our search strategy in PubMed search engine was “(toxicity) or (asphyxia or suffocation) or (drowning) or (poisoning) or (burn or fire) or (traffic accident) or (transportation accident) or (fall) or (death) and in title: Iran* and (infant or child or adolescent) and (prevalence or epidemiology or ratio)”.

2.2. Inclusion and exclusion criteria

Studies were included in the review if they met the following criteria: 1- Cross-sectional design 2- Being performed inside Iran 3- Included children under 20 years old 4- Provided data on frequency of injury-related mortality in children under 19 years or injury-related mortality of children under 5 years, as well as, frequency of different causes of injury mortality (e.g. poisoning, falling, traffic accidents, and drowning).

The articles, for which the full-text was not available, were excluded. Another exclusion criterion was lack of information about injury-related child mortality. In addition, Letter to editors, unstructured papers, proceeding papers, theses, and dissertation were excluded.

2.3. Study selection and screening

Two independent inspectors (A.B and N.E) searched the databases following the development of the project protocol. All search results were exported into the EndNote X7 software (Thomson Reuters, New York, NY, USA). The two inspectors independently screened studies for the inclusion criteria (that was determined before in protocol) and the third reviewer (A.A.R) assessed the inconsistencies between the two reviewers. The flow diagram of the review process is shown in Fig. 1.

2.4. Data extraction and quality assessment

Two independent inspectors used the Newcastle-Ottawa scale (Global Burden of Disease et al.) to assess the methodological quality of the included studies. Studies with NOS scores of 1–4 were considered as low-quality, whereas scores 5–6 indicated intermediate-quality, and those scored 7–8 were regarded as high-quality studies (Akhavan Rezayat et al., 2018; Shen et al., 2016).

Quality scores were independently assigned by two reviewers (N.E) and (A.B) and verified by the third one (A.A.R). Results of quality assessment have been summarized in Table 1.

We designed and finalized the data extraction form based on sample studies retrieved by an initial search. Two independent inspectors gathered the information based on the following parameters: (1) Author names, publication year, study site (location); (2) Sample size; (3) Age range; (4) The rate of injury mortality; (5) The proportion of injury mortality to total child mortality; (6) The rate

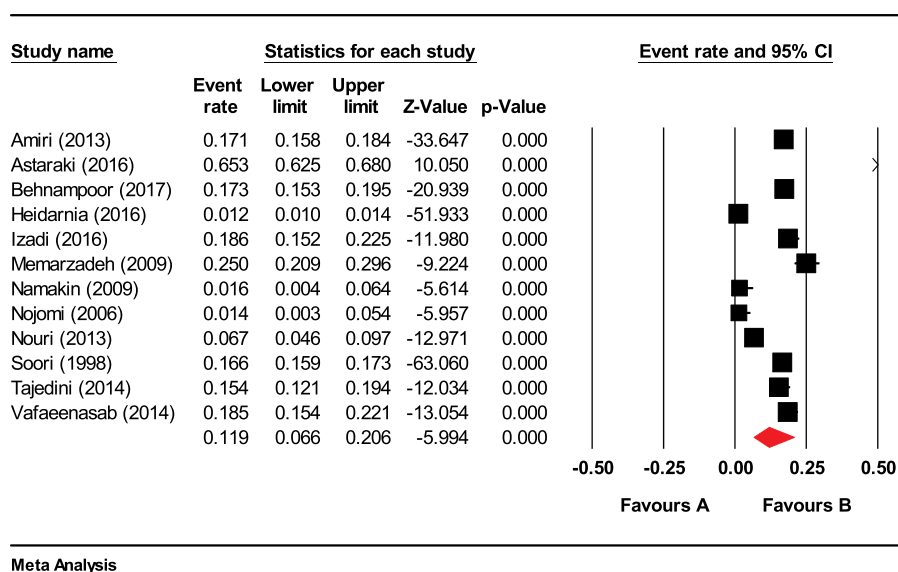


Fig. 2. The proportion of injury in all-cause child mortality in Iran: a diamond data marker represents the overall frequency and 95% CI for the outcome of interest.

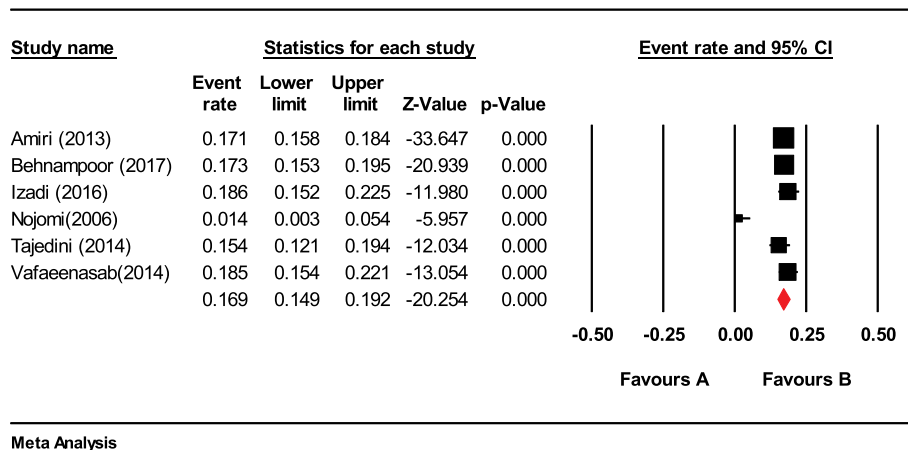


Fig. 3. The proportion of injury in all-cause mortality in children below 6 years old in Iran: a diamond data marker represents the overall frequency and 95% CI for the outcome of interest.

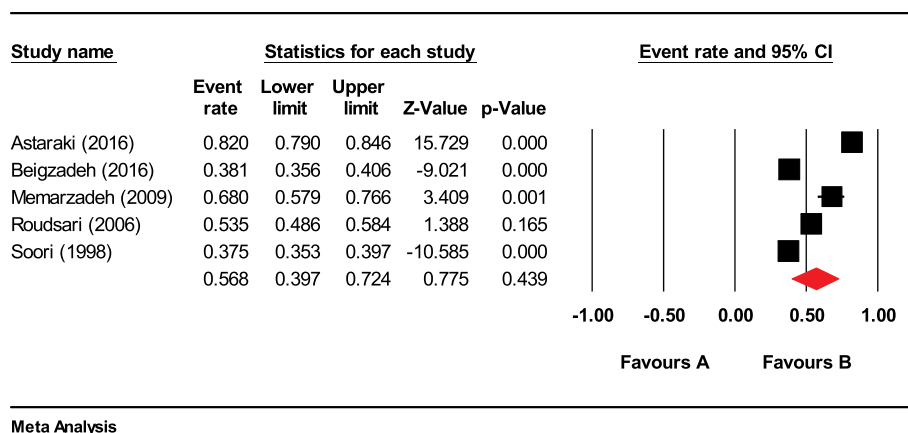


Fig. 4. The proportion of traffic accident in all-cause injury-related child mortality in Iran: a diamond data marker represents the overall frequency and 95% CI for the outcome of interest.

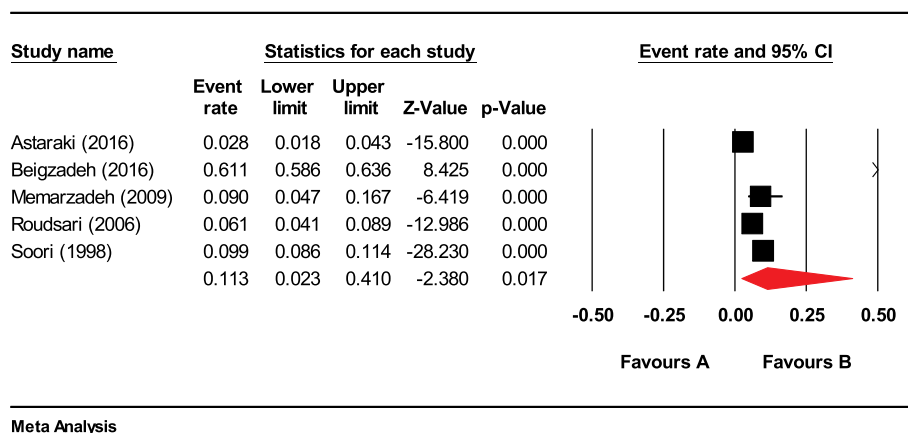


Fig. 5. The proportion of falling in all-cause injury-related child mortality in Iran: a diamond data marker represents the overall frequency and 95% CI for the outcome of interest.

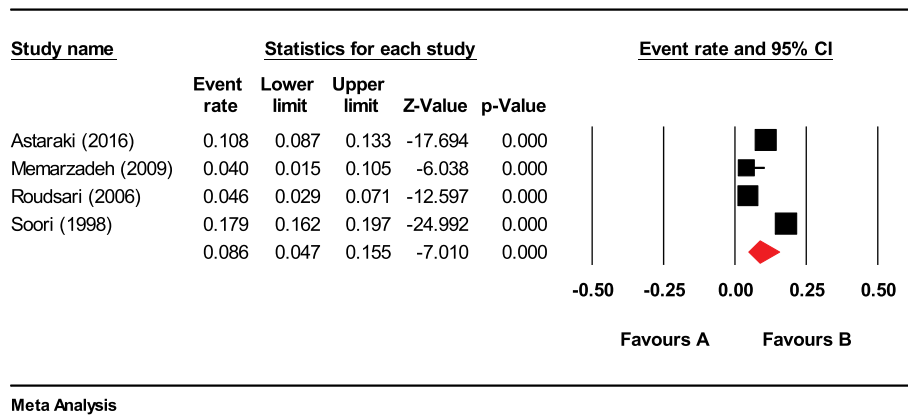


Fig. 6. The proportion of drowning in all-cause injury-related child mortality in Iran: a diamond data marker represents the overall frequency and 95% CI for the outcome of interest.

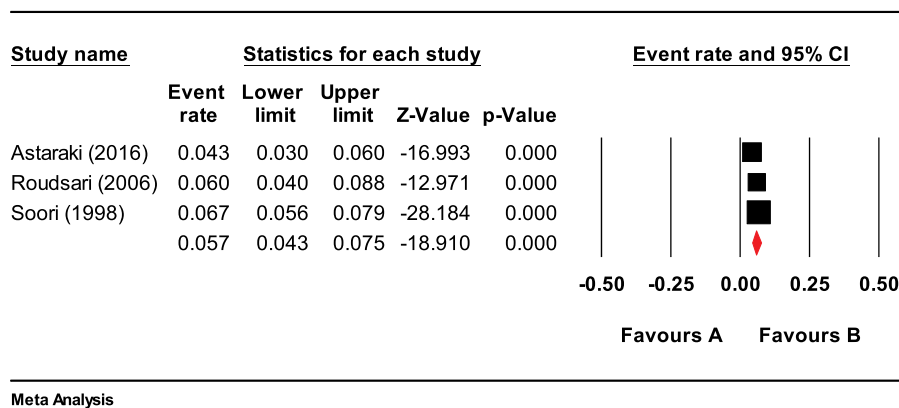


Fig. 7. The proportion of poisoning in all-cause injury-related child mortality in Iran: a diamond data marker represents the overall frequency and 95% CI for the outcome of interest.

of road accident; (7) The proportion of road accident mortality to total injury mortality; (8) The rate of drowning mortality; (9) The proportion of drowning mortality to total injury mortality; (10) The rate of poisoning mortality; (11) The proportion of poisoning mortality to total injury mortality; (12) The rate of falling mortality and (13) The proportion of falling mortality to total injury mortality.

2.5. Data synthesis

All the data from reviewed studies were gathered and organized in a table. To calculate the prevalence of all-cause and cause-specific child mortality, data from individual studies were collected using a random effect model. Data were summarized as frequency and 95% confidence interval (95%CI). All analyses were performed using comprehensive meta-analysis software, version 3.3.070 (Biostat, Englewood, NJ, USA). We evaluated our study using preferred reporting items for systematic reviews and meta-analyses (PRISMA) checklist (Supplementary 1).

3. Results

3.1. Characteristics of the studies

Our primary search strategy identified 2262 studies, of which 2086 were retrieved from English databases and 176 were from the Persian ones. After removing duplicates and reviewing titles and abstracts, 78 studies underwent full-text review. Some full-text articles were excluded due to lack of information on injury-related mortality (38 records), study type not being cross-sectional (4 records), and including patients aged above 20 years (20 records). Finally, 14 cross-sectional studies were selected to be included in the systematic review, of which 12 were further included in the meta-analysis, as well. The studies included in our systematic review and meta-analysis are characterized in [Table 1](#).

The included studies comprised a total sample size of 24,683 subjects for systematic review and 22,721 subjects for meta-analysis. Overall, the 14 studies included in systematic review, reported 3846 injury-related child deaths in Iran. Total number of child deaths due to road accidents was 1531, while 1116 children died due to falling, as reported by five studies (Astaraki et al., 2016; Beigzadeh et al., 2016; Memarzadeh et al., 2011; Roudsari et al., 2006; H. Soori and Naghavi, 1998). Four studies reported 350 child deaths due to drowning (Astaraki et al., 2016; Memarzadeh et al., 2011; Roudsari et al., 2006; H. Soori and Naghavi, 1998) and three studies reported 148 deaths due to drowning (Astaraki et al., 2016; Roudsari et al., 2006; H. Soori and Naghavi, 1999).

3.2. Meta-analysis

Twelve observational studies involving 22,721 individuals were included in the meta-analysis (Abed et al., 2013; Amiri et al., 2013; Astaraki et al., 2016; Behnampoor et al., 2017; Heidarnia et al., 2016; Izadi et al., 2016; Memarzadeh et al., 2011; Namakin and Sharifzadeh, 2009; Nojomi et al., 2009; H. Soori and Naghavi, 1998; Tajedini et al., 2014; Vafaenasab et al., 2014). The proportion of injury in all-cause child mortality was 11.9% (95%CI: 6.6%–20.6%) (Fig. 2). In children under 5 years, this proportion was 16.9% (95%CI: 14.9%–19.2%) (Fig. 3) (Amiri et al., 2013; Behnampoor et al., 2017; Izadi et al., 2016; Nojomi et al., 2009; Tajedini et al., 2014; Vafaenasab et al., 2014). The highest mortality rate was due to road accidents with 56.8% of deaths (95% CI: 39.7–72.4; Fig. 4). Falling came in second with 11.3% mortality rate (95% CI: 2.3–41.0; Fig. 5), followed by drowning, which accounted for 8.6% of deaths (95% CI: 4.7–15.5; Fig. 6). Lastly, poisoning caused about 5.7% of child deaths (95% CI: 4.3–7.5; Fig. 7) and the remaining 17.6% of deaths were due to other causes.

4. Discussion

Children, born helpless and dependent, being carried everywhere and protected from danger, experience a substantial change in their surrounding environment as soon as they begin to toddle and walk. They often escape serious supervision of parents, which puts them at high risk of accidents and injuries, making these factors the main cause of death in early stages of life (Linnan et al., 2007). In this study, among all deaths in children aged 1–59 months, we found that 16.9% were caused due to accidents and injuries. Linnan et al. in their report on accident-related child mortality in Asia indicated that about 37% of mortalities in children 1–4 years old was due to injuries (Linnan et al., 2007). Moreover, Centers for Disease Control and prevention (CDC), in their childhood injury report in 2009 showed injury-related mortality rate to be 44% in children aged 1–19 years in the United States (Borse and Sleet, 2009). Traffic injuries have been posited by many studies as the most common cause of mortality in children (Durkin et al., 1999; Hansen et al., 2004; Hasselberg, 2006; Søreide et al., 2007; Souminen et al., 1998). However, the inconsistency in the results might be due to different age thresholds for definition of child mortality and childhood between the mentioned studies and our work. In a study in Iran, it was shown that road accident mortality, in general, was dropped between 1990 and 2016, while the study stated lack of comprehensive information on accidents in Iran as a current challenge and recommended establishing a center to keep record of all data on road accidents in the country (Bazargan-Hejazi et al., 2018). In a study published in 2011, lack of proper using and low safety of vehicles, especially motorcycles, were mentioned as important factors associated with road accidents, although the study was not conducted exclusively on children (Shavaleh et al., 2018). The growing trend of globalization, despite enhancing our knowledge about accident prevention (Bettcher and Wipfli, 2001), can lead to the use of higher number of vehicles in unsafe and non-standard roads, especially in developing countries (Gracey, 2002; Roberts, 2004). This can possibly be one of the reasons for the increase in accident-related child mortality (Huang et al., 2016). It seems that proper policies and effective interventions are needed to reduce road accidents in Iran, as in several developing countries (Balan and Lingam, 2012; Harvey et al., 2009; Huang et al., 2016; Khan et al., 2015; Li et al., 2015).

In this systematic review and meta-analysis, the total injury-related mortality rate of children in Iran was 11.9%. We found that the most common cause of child mortality in Iran was road traffic accidents (56.8%), followed by falling (11.3%), drowning (8.6%), poisoning (5.7%), and other accidents (17.6%). However, in the studies done by Linnan et al. in Asia and Borse et al. in the United States, drowning was the most common cause of death among children aged 1–4 years (Borse and Sleet, 2009; Linnan et al., 2007). This difference might be ascribed to different age range of subjects in the reports, as Borse et al. indicated that the most common cause of accident-related mortality among children aged 5–19 years was road accidents (Borse and Sleet, 2009; Linnan et al., 2007). In addition, it might be due to the high rate of unsafe and aggressive driving behaviors in Iran (Bazzaz et al., 2015).

Drowning was the third leading cause of child death in our study. It was consistent with the results of a global report on unintentional child mortality. In a report in 2016, 18.4% of global child mortality and 14.9% of child deaths in the eastern Mediterranean region were imputed to drowning (Hamid Soori and Khodakarim, 2016). Planning standard swimming education programs for children, providing limited and protected access to coastal areas, and increasing parents' awareness could recline the rate of drowning-related mortality (Adeloye et al., 2018; Global Burden of Disease et al., 2017).

One of the limitations of this study was that there were few valid studies available for evaluation that might be due to under-reporting of accidents or lack of proper care in some rural and less developed areas of the country. Besides, we only considered studies from the past 10 years and reports published before that were excluded due to outdated data. Another limitation was inclusion of relatively higher number of studies from the north of Iran, compared to central parts in which the risk of drowning was lower due to their geographic characteristics. This could in turn lead to a falsely high rate of drowning deaths. Ultimately, since not all of the information regarding child mortality is published, accessing these data was difficult due to low cooperation of responsible organizations and institutes.

5. Conclusion

Our findings indicate a relatively high rate of mortality from road traffic accidents, which should be considered seriously by policy-maker authorities. Initiating preventive strategies and prioritizing the resources in order to achieve better standards of road transportation is of cardinal importance in Iran. Moreover, developing new policies toward raising public awareness about driving safety, improving the safety of roads and vehicles, developing emergency services, enforcing the use of helmets, and child restraints can help decrease injury-related mortality rate. Further wider research is required to exclusively investigate different aspects of road traffic accidents and its predisposing factors, which contribute to developing coherent public health policies that might ultimately prevent these injuries largely.

Ethical approval

This study does not include any human or animal subjects.

Informed consent

This article is a systematic review and meta-analysis and we do not have any human participant in our study.

Financial disclosure

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Declaration of competing interest

There is no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jth.2019.100816>.

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